The invention claimed is:

1. A process for converting carbonaceous feedstock to alcohol comprising:

reforming carbonaceous feedstock into a first syngas stream comprising hydrogen, carbon dioxide and carbon monoxide;

separating the carbon dioxide and a portion of the hydrogen from said first syngas stream, to yield a second syngas stream comprising a reduced amount of hydrogen and carbon monoxide;

passing said separated hydrogen and carbon dioxide through a first catalyzed reactor to produce methanol;

passing said methanol from said first catalyzed reactor, and said second syngas stream, through a second catalyzed reactor to produce ethanol.

2. The process of claim 1 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

3. The process of claim 2 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

4. The process of claim 3 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

5. The process of claim 3 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is about 1.1:1.0.

6. The process of claim 4 in which unreacted carbon dioxide and hydrogen issuing from said first catalyzed reactor are recycled back through said reactor.

7. The process of claim 6 in which unreacted carbon monoxide and hydrogen issuing from said second catalyzed reactor are recycled back through said second catalyzed reactor.

8. The process of claim 6 in which methane produced in said process is allowed to recycle back through said second catalyzed reactor with unreacted hydrogen and carbon monoxide; except that at least some of the time, at least a portion of said unreacted hydrogen, unreacted carbon monoxide and methane stream is diverted to said methane reformer.

9. The process of claim 8 in which methanol exiting said second catalyzed reactor is recycled back through said second catalyzed reactor.

10. The process of claim 4 in which carbon dioxide is separated from said first syngas stream before hydrogen is separated from it, and a portion of the resulting syngas stream is diverted and is used to run a turbine to generate electricity to power compressors and other electrically driven devices used in the process.

11. The process of claim 1 in which said second catalyzed reactor is catalyzed by a catalyst consisting essentially of elemental cobalt as its primary constituent, with minor amounts of manganese, zinc and one of chromium, aluminum and mixtures thereof.

12. The process of claim 11 in which said catalyst additionally includes an alkali or alkaline earth promoter.

13. The process of claim 12 in which said catalyst consists essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

14. The process of claim 11 in which said catalyst consists essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

15. The process of claim 13 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

16. The process of claim 15 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

17. The process of claim 16 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

18. The process of claim 11 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

19. The process of claim 18 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

20. The process of claim 19 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

21. The process of claim 1 in which said step of reforming said carbonaceous feedstock is conducted at elevated temperature in a feedstock reformer, and includes

adjusting the contact time of the syngas at elevated temperatures in the reformer, and adjusting the exit gas temperature of the syngas as it leaves the reformer, to achieve proportions of carbon monoxide, hydrogen and methane most closely approximating those desired given the intended use of the syngas.

22. The process of claim 21 which includes introducing said feedstock and superheated steam into the feedstock reformer at about 204° C. (400° F.);

adjusting said exit temperature of said syngas leaving said feedstock reformer to between about 871° C. (1600° F.) and about 1204° C. (2200° F.);

adjusting said contact time of said syngas within said reformer within a range of from about 0.4 seconds to about 5.0 seconds.

23. The process of claim 22 in which said syngas exit temperature and contact time are adjusted to produce a syngas most optimally proportioned to produce lower alcohols, by adjusting said syngas exit temperature to from about 898° C. (1650° F.) to about 926° C. (1700° F.), and said contact time from about 1.0 seconds to about 3.0 seconds.

24. The process of claim 23 in which said contact time is adjusted to from about 1.0 seconds to about 2.0 seconds.

25. The process of claim 22 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

26. The process of claim 25 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

27. The process of claim 26 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

28. The process of claim 21 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

29. The process of claim 28 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

30. The process of claim 29 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

31. The process of claim 1 in which said step of reforming feedstock into a first syngas stream includes:

comminuting the feedstock;

entraining the comminuted feedstock in a stream of inert gas and conveying it to a feed hopper where it is maintained in an inert gas environment;

metering the flow rate of feedstock into said reformer by a rotary valve through which the feedstock is fed, said rotary valve comprising a plurality of separate compartments which rotate from a valve inlet at which comminuted feedstock is fed into a valve compartment, to a valve outlet at which comminuted feedstock flows from said rotary valve;

feeding said feedstock through a feed conduit leading from said rotary valve outlet to a stream of steam under pressure into which the feedstock is fed and entrained;

feeding inert gas into said feed conduit under pressure, to prevent the steam under pressure from creating a back pressure in said feed conduit which would prevent comminuted feedstock from feeding into said stream of steam under pressure;

feeding inert gas under pressure into said rotary valve such that it pressurizes a compartment after it has passed said rotary valve inlet and before it has reached said

rotary valve outlet whereby the comminuted feedstock contained in said compartment is maintained under pressure;

providing a vent in said rotary valve at a point between said outlet and said inlet, in the direction in which said compartments are rotated, such that a compartment under pressure which has been emptied at said outlet and is returning to said inlet will be vented of pressure introduced when said inert gas is fed into said compartment under pressure, before the emptied compartment reaches said rotary valve inlet;

feeding the steam entrained stream of comminuted feedstock to a feedstock reformer.

32. The process of 31 in which said comminuted feedstock is dried to a moisture content of from about 5% to about 20% before being fed into said feed hopper.

33. The process of claim 32 in which said feedstock is dried to a moisture content of from about 9% to about 15% before it is fed into said feed hopper.

34. The process of claim 31 in which said stream of inert gas comprises flue gas.

35. The process of claim 34 in which said flue gas is the exhaust gas from the carbonaceous feedstock reformer into which the comminuted feedstock and steam are fed.

36. The process of claim 31 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

37. The process of claim 36 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

38. The process of claim 37 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

39. The process of claim 1 in which said step of reforming said carbonaceous feedstock is conducted at elevated temperature in a feedstock reformer, and includes adjusting the contact time of the syngas at elevated temperatures in the reformer, and adjusting the exit gas temperature of the syngas as it leaves the reformer, to achieve proportions of carbon monoxide, hydrogen and methane most closely approximating those desired given the intended use of the syngas; and in which said second catalyzed reactor is catalyzed by a catalyst consisting essentially of elemental cobalt as its primary constituent, with minor amounts of manganese, zinc and one of chromium, aluminum and mixtures thereof.

40. The process of claim 39 which includes introducing said feedstock and superheated steam into the feedstock reformer at about 204° C. (400° F.);

adjusting said exit temperature of said syngas leaving said feedstock reformer to between about 871° C. (1600° F.) and about 1204° C. (2200° F.);

adjusting said contact time of said syngas within said reformer within a range of from about 0.4 seconds to about 5.0 seconds.

41. The process of claim 40 in which said second catalyzed reactor is catalyzed by a catalyst consisting essentially of elemental cobalt as its primary constituent, with minor amounts of manganese, zinc and one of chromium, aluminum and mixtures thereof.

42. The process of claim 41 in which said catalyst consists essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

43. The process of claim 42 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

44. The process of claim 43 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

45. The process of claim 44 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

46. The process of claim 39 in which said step of reforming feedstock into a first syngas stream includes:

comminuting the feedstock;

entraining the comminuted feedstock in a stream of inert gas and conveying it to a feed hopper where it is maintained in an inert gas environment;

metering the flow rate of feedstock into said reformer by a rotary valve through which the feedstock is fed, said rotary valve comprising a plurality of separate compartments which rotate from a valve inlet at which comminuted feedstock is fed into a valve compartment, to a valve outlet at which comminuted feedstock flows from said rotary valve;

feeding said feedstock through a feed conduit leading from said rotary valve outlet to a stream of steam under pressure into which the feedstock is fed and entrained;

feeding inert gas into said feed conduit under pressure, to prevent the steam under pressure from creating a back pressure in said feed conduit which would prevent comminuted feedstock from feeding into said stream of steam under pressure;

feeding inert gas under pressure into said rotary valve such that it pressurizes a compartment after it has passed said rotary valve inlet and before it has reached said rotary valve outlet whereby the comminuted feedstock contained in said compartment is maintained under pressure;

providing a vent in said rotary valve at a point between said outlet and said inlet, in the direction in which said compartments are rotated, such that a compartment under pressure which has been emptied at said outlet and is returning to said inlet will be vented of pressure introduced when said inert gas is fed into said compartment under pressure, before the emptied compartment reaches said rotary valve inlet;

feeding the steam entrained stream of comminuted feedstock to a feedstock reformer.

47. The process of 46 in which said comminuted feedstock is dried to a moisture content of from about 5% to about 20% before being fed into said feed hopper.

48. The process of claim 47 in which said feedstock is dried to a moisture content of from about 9% to about 15% before it is fed into said feed hopper.

49. The process of claim 48 in which said stream of inert gas comprises flue gas.

50. The process of claim 49 in which said flue gas is the exhaust gas from the carbonaceous feedstock reformer into which the comminuted feedstock and steam are fed.

51. The process of claim 46 which includes introducing said feedstock and superheated steam into the feedstock reformer at about 204° C. (400° F.);

adjusting said exit temperature of said syngas leaving said feedstock reformer to between about 871° C. (1600° F.) and about 1204° C. (2200° F.);

adjusting said contact time of said syngas within said reformer within a range of from about 0.4 seconds to about 5.0 seconds.

52. The process of claim 51 in which said second catalyzed reactor is catalyzed by a catalyst consisting essentially of elemental cobalt as its primary constituent, with minor amounts of manganese, zinc and one of chromium, aluminum and mixtures thereof.

53. The process of claim 52 in which said catalyst consists essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

54. The process of claim 53 in which methane formed in the process is passed with steam through a methane reformer to produce carbon monoxide and hydrogen; said carbon monoxide and hydrogen formed in said methane reformer being also passed through said second catalyzed reactor.

55. The process of claim 54 in which carbon dioxide leaving said second catalyzed reactor is also passed through said first catalyzed reactor.

56. The process of claim 55 in which the amount of hydrogen removed from said syngas stream is adjusted such that the ratio of hydrogen to carbon monoxide passing through said second catalyzed reactor is from about 1.1:1.0 to about 1.3:1.0.

57. A catalyst consisting essentially of elemental cobalt as its primary constituent, with minor amounts of manganese, zinc and one of chromium, aluminum and mixtures thereof.

58. The catalyst of claim 57 which additionally includes an alkali or alkaline earth promoter.

59. The catalyst of claim 58 consisting essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

60. The catalyst of claim 57 consisting essentially of from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof.

61. A catalyst made by mixing the salts of cobalt, manganese, zinc, and one of chromium, aluminum and mixtures thereof, and an alkali or alkaline earth salt, in proportions such that the elemental content of cobalt, manganese, zinc and one of chromium, aluminum and mixtures thereof, relative to one another is as follows:

from about 65% to about 75% elemental cobalt, about 4% to about 12% manganese, about 4% to about 10% zinc, and about 6% to about 10% of one of chromium, aluminum or mixtures thereof;

pelletizing the mixture, either by forming pellets of the mixture, or loading the mixture onto carbon pellets;

exposing the resulting pellets to a reducer doped inert gas at elevated temperature and pressure until the cobalt, manganese, zinc and one of chromium, aluminum and mixtures of salts have been substantially reduced.

62. The catalyst of 61 in which said step of exposing the resulting pellets to a reducer doped inert gas at elevated temperature and pressure comprises:

preheating an inert gas doped with a small amount of hydrogen to a temperature of about 200° C., and exposing said pellets to a reducer doped inert gas under a pressure of about 172 KPa (25 pounds per square inch (psig)) to about 207 KPa (30 psig), causing said pellets to heat to about 400° C.;

measuring the pellet temperature and the gas temperature, and as the pellet and gas temperature fall off, introducing additional amounts of hydrogen into the gas stream, building over time to a level of from about 25% to about 30% hydrogen;

gradually increasing pressure over time until it reaches from about 4137 KPa (600 psig) to about 6895 KPa (1000 psig);

after additional hydrogen ceases to be effective in maintaining the pellet and gas temperature, gradually adding carbon monoxide to the reducer doped stream of inert gas, and continuing such addition until the pellet temperature and gas temperature continue to fall in spite of the incremental addition of carbon monoxide;

cooling the pellets and storing them under an inert gas purge until they are ready for use.

63. An apparatus comprising:

a carbonaceous feedstock reformer for generating syngas;

first conduit defining a flow path through which syngas flows;

a carbon dioxide separator located in said flow path downstream from said feedstock reformer;

a hydrogen separator located in said flow path downstream from said feedstock reformer;

an ethanol catalyzed reactor located in said flow path downstream from said carbon dioxide separator and said hydrogen separator;

second and third conduits connecting said carbon dioxide separator and said hydrogen separator, respectively, to a methanol catalyzed reactor for feeding carbon dioxide and hydrogen to said methanol catalyzed reactor;

fourth conduit connecting said methanol catalyzed reactor to said ethanol catalyzed reactor.

64. The apparatus of claim 63 which includes:

a gas separator for separating gas from liquid exiting said ethanol catalyzed reactor;

a methane reformer, and a fifth conduit connecting said gas separator to said methane reformer; and

sixth conduit connecting said methane reformer to said first conduit upstream from said hydrogen separator.

65. The apparatus of claim 64 which includes a second carbon dioxide separator located in said fifth conduit; and a seventh conduit connecting said second carbon dioxide separator to said methanol catalyzed reactor.

66. The apparatus of claim 64 in which a eighth conduit extends from said gas separator back to said alcohol reactor for recycling said gas stream; and a diverter valve

between said fourth and fifth conduit which is activated from time to time to divert gas from said eighth conduit to said fourth conduit.

67. The apparatus of claim 66 which includes a meter in said eighth conduit for measuring the methane content of gas therein; said diverter valve being operably connected to said meter, and operating in response to said meter sensing a particular level of methane to divert said gas to said fourth conduit.